Space Weather Technical Forecast

Issued on Monday, 28 February 2022 at 00:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Increasing electron fluence possible. Slight chance of R1/Minor radio blackouts. Slight chance of G1/Minor Storm, increasing Day 4 (03 Mar).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity was Low in the last 24 hours with a C1.5 flare observed at 27/0626 UTC, from a region in the southeast which was subsequently numbered AR2957. There are currently four sunspot regions on the visible disc, all of which are small and simple at the present time. The two regions in the eastern hemisphere have been developing however and will be monitored for any further growth.
No Earth-directed CMEs were observed in the available imagery during the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, showed a CIR and subsequent transition into a positive polarity high speed stream. There are three coronal holes in the western hemisphere so the exact source is uncertain though it is most likely CH58. Wind speed was initially at background levels, near 350 km/s, and increased through the period to reach around 500 km/s. The density rose above average after 27/0100 UTC, reaching a maximum value of around 18 ppcc, then slowly decreased to mainly average levels. The IMF Bt was weak initially, increasing to Moderate levels reaching 14 nT at 27/0630 UTC, before declining to reach 7-9 nT. The north-south component, Bz, varied weakly at first however around 27/0630 UTC the negative Bz fell to around -14 nT, before varying more weakly again between +10/-7 nT. Phi angle was largely positive (away from the Sun). Resultant geomagnetic activity was Quiet to Unsettled (Kp 0-3) with an Active (Kp 4) interval between 27/0600-0900 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES 16 was at background levels. The high energy electron flux (greater than 2 MeV) was initially at moderate levels, but fell to background with the CIR, just after 27/0300 UTC. The corresponding 24-hour integrated electron fluence remained below the Active (1e8 integrated pfu) threshold on a declining trend. The 28/0001 UTC observation was 5.33e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to be low or very low, with a chance of further C-class flares. There is just a slight chance of M-class flares. This may increase slightly in the coming days, with a couple of potential regions rotating on in 2-3 days time.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently forecast. A series of coronal hole high speed stream (HSS) connections are expected during this period, with winds likely to exceed 500 km/s at times. Geomagnetic activity is expected to be Quiet to Active, with a very slight chance of G1/Minor Storm intervals. This declining to mainly Quiet during Day 3. We may see a further coronal hole high speed stream later on Day 4, this is more likely to give G1/Minor Storm periods due to the time of year and negative polarity, although the timing is uncertain.

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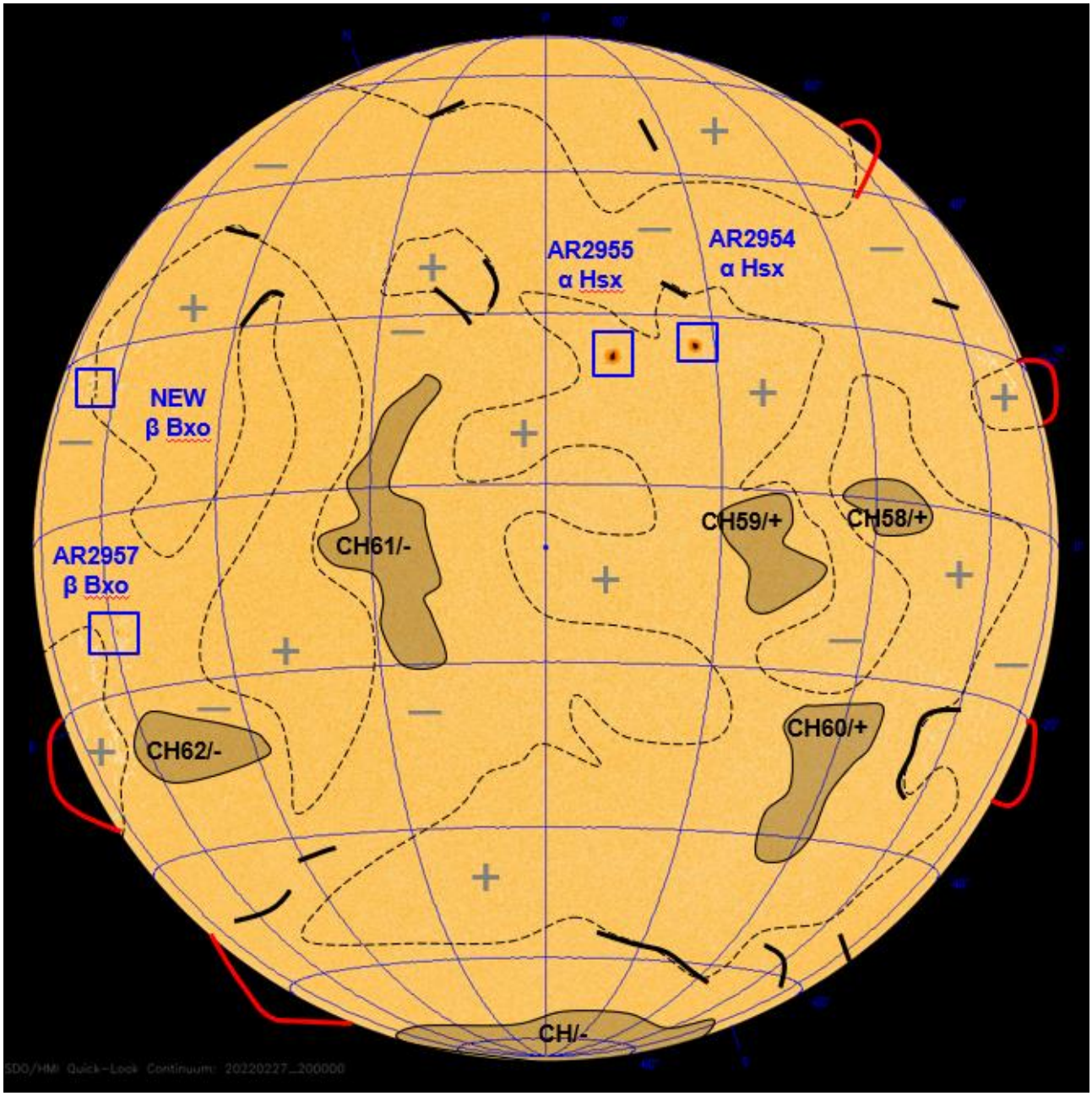
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. High energy electron flux is likely to follow an erratic rising trend, with the possibility of exceeding the high (1e3 pfu) threshold during diurnal peaks. Electron fluence is also forecast to follow an erratic rising trend, and may approach the Active (1e8 integrated pfu) threshold later in the forecast period, although currently expected to remain just below. Confidence is low however.

Figure 1. Solar Analysis Valid 27/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are currently no Earth-directed CMEs forecast.
Solar wind speeds are currently at elevated levels following a connection with the high speed stream from either coronal hole 58 or 60. A further connection with coronal hole 59 is then probable on Days 1 or 2 (28 Feb - 01 Mar), with elevated wind speeds likely lasting into Day 3 (02 Mar) before slowly easing. It is probable that the effects will merge, making it difficult to tell the individual features apart when they arrive at L1. These features appeared weaker in imagery on the previous rotation, and wind speeds from the previous rotation were also contaminated by CME arrivals.

There is a further coronal hole 61, which is negative polarity, and this may arrive later on Day 4 (03 Mar). The timing of this persistent feature is a little uncertain however, due to CME contamination on the previous rotation, and it may arrive after the end of this period.

The coronal holes through Days 1 and 2 are all positive polarity, which are less favoured for a significant geomagnetic response at this time of year. As such, geomagnetic activity is expected to be Quiet to Active, with a very slight chance of G1/Minor Storm intervals. This declining to mainly Quiet during Day 3. If coronal hole 61 does arrive later on Day 4, this is more likely to give G1/Minor Storm periods due to the time of year and negative polarity.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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Figure 2: AIA-193 imagery showing this rotation (left) and previous rotation (right). CH58, 59 and 60 are all much clearer on this rotation. CH61 and 62 are both in similar positions to previous rotation. However, wind speeds on the previous rotation were contaminated by CMEs.

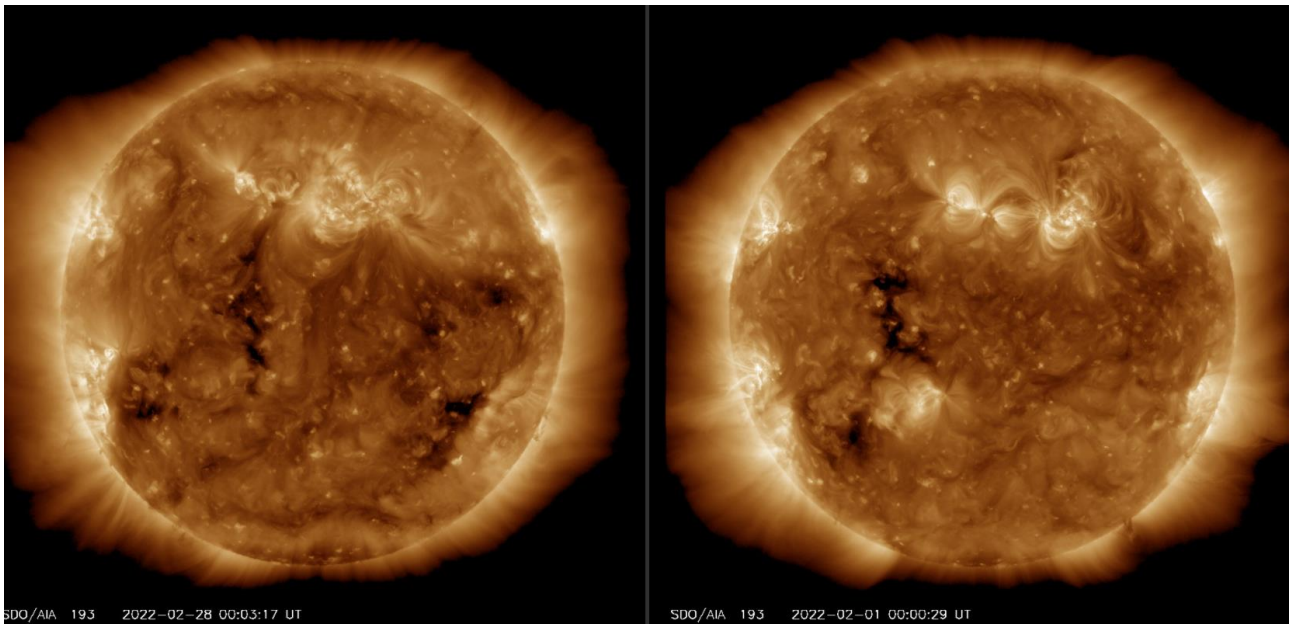
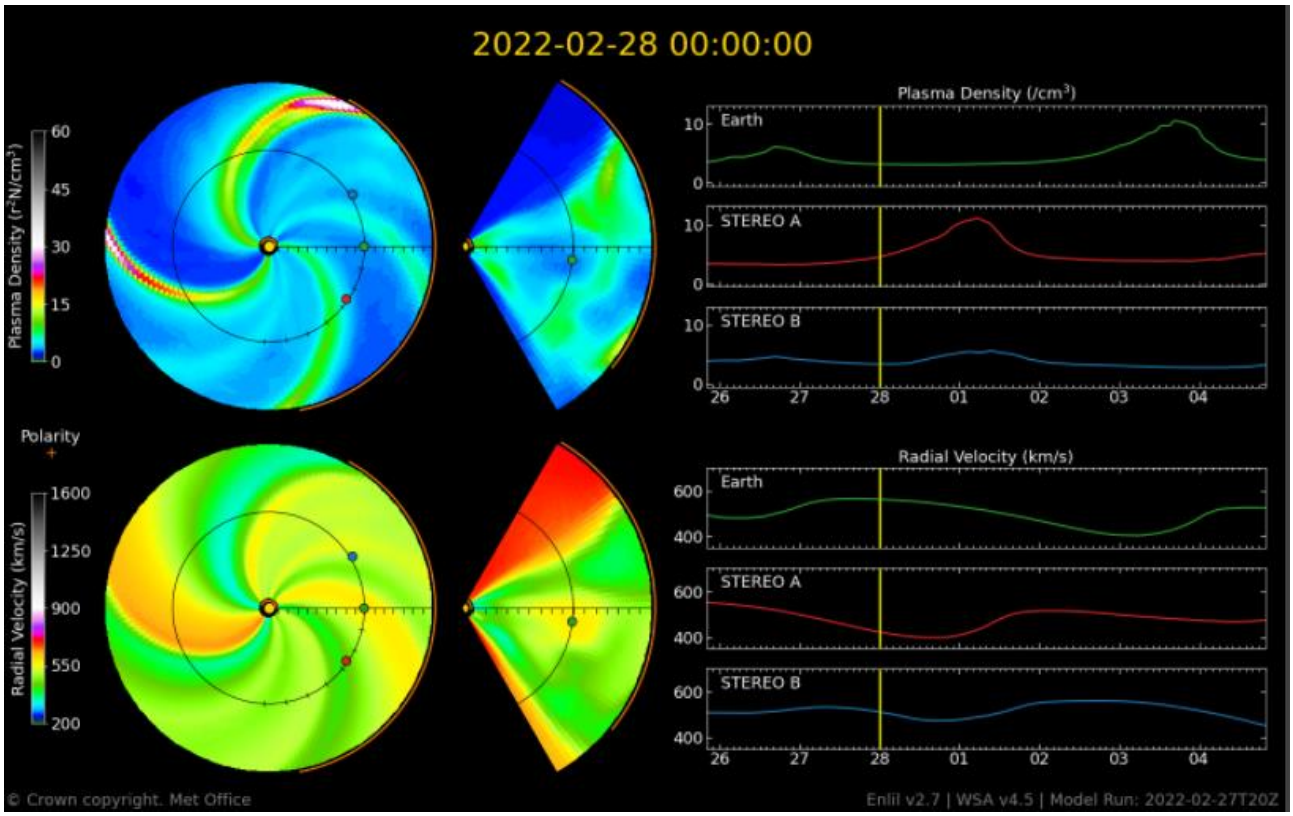


Figure 3: Enlil model is currently considered to be providing reasonable guidance on wind speeds.



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Radio Blackouts - X-Ray Flares:

Solar activity is currently at Low levels, with one C-class flare in the last 24 hours. There are currently four sunspot regions on the visible disc. AR2954 and AR2955 are both mature and stable, classified as Hsx/Alpha, and have shown little activity. Two further active regions have developed, AR2957 in the southeast and a NEW region in the northwest, both currently classified Bxo/Beta. However as these have been developing they will be closely monitored for further growth. Another region in the northwest was numbered AR2956, but this has subsequently faded. There are a couple of potential regions showing as bright spots on STEREO-A EUVI imagery, but these are 2-3 days away from rotating onto the Earth facing disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES 16 is at background levels, and expected to remain at this level with no solar radiation storms occurring.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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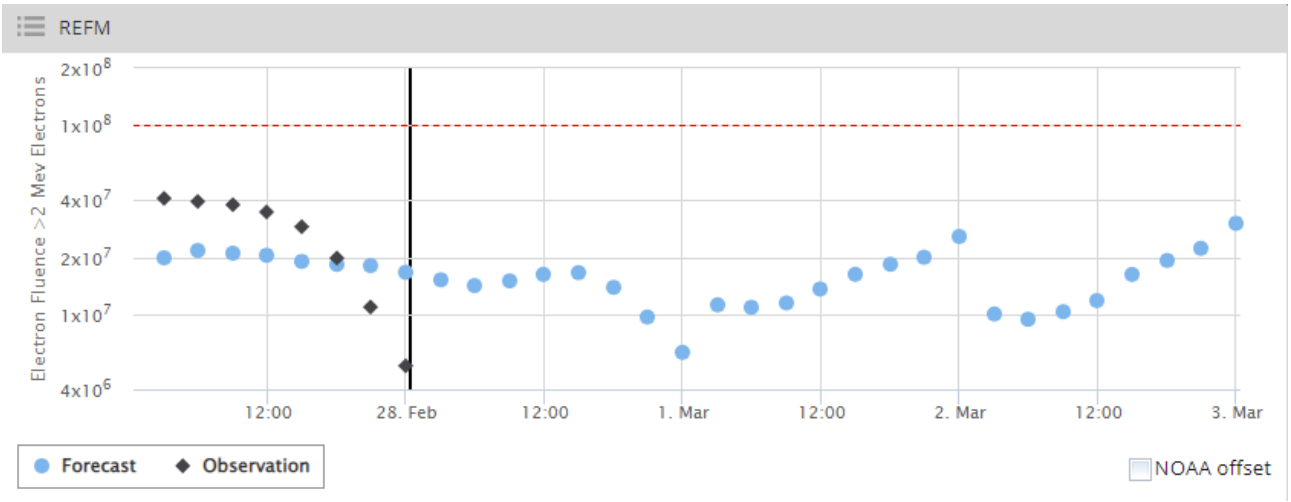
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2 MeV) has dropped out to background levels following the recent CIR. However, with Earth expected to be affected by various high speed streams in the coming days further charging is likely to occur. Any CIR associated with these arrivals may cause temporary suppression, however an erratic increasing trend is most probable over the coming days, but with some variation in the peak values day to day.

Associated electron fluence is likely to rise due to charging from the various high speed streams, but the level it will reach is subject to some uncertainty. Confidence is low, due to the uncertainty surrounding the charging / suppression cycle of several high speed streams in the coming days.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	20	30	40
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: REFM model is showing a varying trend through the next three days. As persistence is not a good guide at the current time, REFM is not expected to be handling this situation very well. An erratic upward trend is most likely, although low confidence.



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